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The IRAW@Bagan project is striving to generate an integrated socio-ecological history for residential patterning, agricultural practices, and water management at the Classical Burmese (Bama) capital of Bagan, Myanmar (11th to 14th centuries CE) across a range of significant ecological, climatic, economic, socio-political, and religious changes. This objective is being achieved through a settlement archaeology study within the peri-urban (mixed urban-rural) settlement zone immediately surrounding Bagan’s regal-ritual epicenter, which is still clearly defined by remnants of its original walls and moat. The importance of our ongoing program of survey, excavations, and geo-spatial inquiry is grounded in the fact that our current understanding of Bagan society continues to be biased towards its upper echelons, namely its high-ranking nobles and religious institutions. Our program of settlement archaeology will ultimately: 1) generate a more nuanced understanding of Bagan as a dynamic capital city; 2) provide insights into the unique characteristics of early urbanism in the tropics; and, 3) contribute to considerations of resilience and vulnerability in contemporary tropical metropolises.

Given their potential for enhancing our understanding of past societies, it is surprising that the settlement patterns and residential architecture of the classical period polities of Southeast Asia have rarely received any focused attention (Miksic and Goh 2017:26, 358). Indeed, Charles Higham (2017:369) opens his recent chapter on The Prehistoric House: A Missing Factor in Southeast Asia, by lamenting that: “Excavations in Mainland Southeast Asia have yet to reveal a single complete house plan, yet the potential of residential archaeology to illuminate social change…is emphasized by recent research in other parts of the world.” The truth of the matter is that, other than a few exceptions – namely the investigations by John Miksic (2012) and his team at Trowulan, and Miriam Stark and her colleagues in the Greater Angkor region (Carter et al. 2018; Stark et al. 2015; see also Bâty 2005, 2010; Ea Darith, and Kyle Latinis 2017) –
archaeological research designs across Southeast Asia continue to disregard the potential of settlement pattern studies.

The lack of attention paid to settlement patterns and vernacular architecture undoubtedly reflects a long-standing partiality towards elite-focused art, architecture, epigraphy, and historical narratives. Beyond the obvious intellectual draw of the written word, and the aesthetic appeal of art and architecture, this traditional approach to knowledge creation continues to be perpetuated because the more mundane houses and material culture inventories indicative of domestic life in the world’s tropical zones – for both elites and commoners alike – are simply considered less interesting, and they tend to be highly perishable, and thus less likely to preserve in the archaeological record. These conceptual and taphonomic biases do not, however, diminish the fact that, should we truly desire to reconstruct the nature of the region’s classical polities – especially their socio-economic systems, demographic trajectories, political hierarchies, socio-spiritual structures, and urban footprints – it is crucial to build a detailed understanding of their support populations. How, one might ask, are we to fully assess the explanatory potential of the much-ballyhooed concept of dispersed or low-density urbanism (e.g., Fletcher 2009, 2012; Wheatley 1971, 1983) without any real material evidence concerning the residential neighborhoods we presume were the basic building blocks of the vast peri-urban zones of the pre-industrial cities under consideration? Surely the idealized perceptions of such communities that have been formed using the elite-centric inscriptions, chronicles, architectural embellishments, and artworks cannot be deemed sufficient to meet such a challenge?

In efforts to help fill this gap in our understanding, the IRAW@Bagan project was developed with the explicit goal of generating an integrated socio-ecological history for residential patterning, agricultural practices, and water management at the classical Burmese (Bama) capital of Bagan, Myanmar (11th to 14th century CE; Figure 1). This objective is being achieved through a settlement archaeology study within the peri-urban, or mixed urban-rural, settlement zone immediately surrounding Bagan’s regal-ritual epicenter (Figure 2), which is still clearly defined by remnants of its original walls and moat (Figure 3). The importance of the proposed program of survey, excavations, and geo-spatial inquiry is grounded in the fact that our current understanding of Bagan society continues to be biased towards its upper echelons, namely its high-ranking nobles and religious functionaries. A settlement archaeology study within Bagan’s peri-urban zone will: 1) generate a more nuanced understanding of Bagan as a dynamic capital city; 2) provide insights into the unique characteristics of early urbanism in the tropics; and, 3) contribute to considerations of resilience and vulnerability in contemporary tropical metropolises.

The IRAW@Bagan Approach to Settlement Archaeology

The principal datasets that have been successfully used to craft integrated socio-ecological histories in our earlier Socio-ecological Entanglement in Tropical Societies (SETS) project (Iannone 2014a, 2014b, 2015, 2016; Iannone et al. 2015) are once again serving as the primary focus of the three sub-projects at the base of the IRAW@Bagan settlement archaeology study: residential patterning, agricultural practices, and water management. These sub-projects are employing a range of tools and approaches to achieve their goals, including systematic ground reconnaissance and surface exposure assessments, remote sensing (i.e., drone imagery), geospatial and landscape analysis (GIS), horizontal and vertical excavations, collection and analysis of palaeoenvironmental ecofacts, detailed analysis of architecture, art historical imagery,
and artifacts, ethnoarchaeological observation and analogy building, ethnographic and ethnohistoric information, considerations of epigraphic materials and historical narratives, and extensive literature reviews.

Figure 1. Map of Southeast Asia showing the location of Bagan and a number of the contemporaneous capitals of the classical era.

Figure 2. The area encompassing Bagan’s peri-urban settlement zone, currently under investigation by the IRAW@Bagan research team.
The Residential Patterning Sub-Project

The Bagan epicenter, as is true for other historic Myanma capitals, was an “exemplary” center that was imbued with cosmological and regal-ritual significance, at the same time that it was home to royals, nobles, military leaders, guards, servants, and elite craft workers (Aung-Thwin 1985:50-51, 1987:88, 94-98; Aung-Thwin and Aung-Thwin 2012:81, 100-101; Daw Thin Kyi 1966:187; Hudson 2004:221; Kan Hla 1977:21). That said, Bagan’s epicenter clearly “represents an elite core, not an urban boundary” (Hudson 2004:221), given that a dense amalgamation of brick temple complexes, stupas, and monasteries extends out and away from the walled enclosure in all directions, thereby forming an extensive peri-urban settlement zone exhibiting a mixed urban-rural character (see also Aung-Thwin and Aung-Thwin 2012:101; Kan Hla 1977:21). Most of these monuments were constructed during Bagan’s florescence (Hudson 2004:236), with the basic spatial extent of the peri-urban zone having been established by the end of the 11th century CE (Kan Hla 1977:18). By the end of the 13th century, the city of Bagan covered around 80 km² (Grave and Barbetti 2001:75; Hudson 2004:237; Hudson et al. 2001:48; Moore et al. 2016:294; Pichard 1992-2003; c.f., Aung-Thwin and Aung-Thwin 2012:91), and encompassed at least 2200 brick temples (Hudson 2004:236; Kan Hla 1977:15), and possibly as many as four thousand (Aung-Thwin 1985:169; Kan Hla 1977:15; Pichard 1992-2003).

It is generally assumed that Bagan’s peri-urban zone was home to a diverse support population (Daw Thin Kyi 1966:187; Hudson et al. 2001:70; Miksic 2001:100; Strachan 1989:7), but we know very little about the settlement patterning associated within this city-scape. Through survey, horizontal and vertical excavations, and detailed artifact analysis, the residential patterning sub-project is examining the temporal and spatial aspects of Bagan’s peri-urban settlement zone to assess how its residents and their varied activities were distributed across the landscape, over both time and space. These investigations are building upon the initial settlement survey and collateral excavations conducted by Bob Hudson (2004:245) and his colleagues (Hudson et al. 2001), which suggested that certain concentrations of small monuments dating to the 11th to 13th centuries may be indicative of the presence of peri-urban settlement clusters (Hudson 2004:212, 245-266, 247; Hudson et al. 2001:62, Figure 9). Indeed, this settlement clustering is argued to have been instrumental to the development of Bagan’s urban footprint (Hudson 2004:219-220). Such findings are consistent with what has been referred to elsewhere in the tropics as “urban clustering” (Isendahl 2010:545; Isendahl and Smith...
2013:133; McIntosh 1991, 2005; McIntosh and McIntosh 2003; Smith 2011:51, 54), a residential settlement pattern often associated with dispersed (Iannone 2015:251-252; Wheatley 1971, 1983) or “low-density” urbanism (Barthel and Isendahl 2013:227; Chase et al. 2011; Fletcher 2009, 2012; Isendahl 2010; Isendahl and Smith 2013; Lucero et al. 2015; Scarborough et al. 2012; Scarborough and Lucero 2010; Sinclair 2010:24; Smith 2010a:234, 2010b:145, 2012:16; Waldheim 2010:4-5). Given that they would have been situated within a distinctly mixed urban-rural city-scape, such clusters are best conceived of as “neighborhoods” rather than “villages” (Smith 2010b, 2011), the latter being more indicative of districts that are purely rural in character.

Considering the preliminary nature of our investigations, the immediate goals of the residential patterning sub-project are simply to find ancient living surfaces, and to ideally reveal the ancient city’s first complete house plans. As is common practice in such “exploratory” situations, our initial investigations are employing non-probabilistic (purposive/judgmental) sampling methods to enhance the potential for finding buried residential features (Banning 2002:28-29; French 2015:21). This sampling strategy has been informed by prior archaeological observations concerning the possible locations of settlement clusters at Bagan (Hudson 2004:208-220, 234--266; Hudson et al. 2001:53-62). Guided by this knowledge, preliminary surface reconnaissance in May 2017 resulted in the discovery of four possible residential neighborhoods (PRN), based on the presence of comparatively high-density surface scatters (HDSS) of ceramics: 1) Shwe Creek, 2) Otein Taung, 3) South Wall, and, 4) Kiln #4 (Figure 4). Beginning in May 2019, quadrant-based surface collection of diagnostic sherds and special finds will be initiated at these four loci (Figure 5), in conjunction with sub-surface testing using paired 1 x 4 m excavation trenches (Figure 6). Pending the results of the test trenches, larger 4 x 4 m horizontal exposures will be used to examine any evidence for buried residential features, such as posthole configurations.

Figure 4. The location of the four possible residential neighborhoods to be tested by IRAW@Bagan (note the extensive field system covering the area).
Our four test excavations sites will also be used to anchor four 200 m wide survey transects of varying length (Figure 7). These will bisect Bagan’s peri-urban settlement zone. The GPS-guided pedestrian survey of these transects will emphasize the rapid and efficient identification of other locales deemed indicative of possible residential neighborhoods. This will be accomplished through the discovery and documentation of additional high-density surface scatters (HDSS) of artifacts, defined as those that meet or exceed a minimal density criteria (MDC) of 25 artifacts per square meter, over a contiguous area of at least 100 square meters. Each transect will be divided into a series of survey lines spaced 10 m apart. These will be assigned a unique, sequential designation and digitized over satellite imagery. Individual field walkers will progress along their designated survey lines in increments of 50 m, completing what is referred to as a 50 x 10 m transect unit (TU). These transect units will form the basic spatial unit for data recording along each of the transects. The transect survey will be facilitated by scheduling our fieldwork in May, coinciding with the end of the dry season and the time when ground cover at Bagan is particularly sparse. The findings from this reconnaissance program will be used to determine the locations for future residential neighborhood test excavations.

**Agricultural Practices Sub-Project**

The agricultural practices sub-project is building upon earlier assessments of Bagan’s agricultural capacity carried out by Michael Aung-Thwin (1990). Given the palimpsest quality of agricultural field systems, it will be necessary to use remote sensing data, geospatial analysis, sub-surface testing and sediment analysis, historic and art historical data, and both ethnographic and ethnoarchaeological observations to build an understanding of Bagan’s relic field system (see Figure 4). Such assessments will be augmented by palynological analyses and ethnobotanical studies. Of interest is the fact that risk husks incorporated in clay bricks have
been used to assess the types of rice grown in Bagan’s major cultivation zones, with over 95.8% of the samples recovered representing the round (Japonica) variety (Aung-Thwin 1990:8). Also of methodological relevance is recent GIS research in Cambodia, where the geometric differences in bunded rice paddy orientations, and their spatial orientations to datable Angkorian temples, canals, ponds, water tanks (barays), or roads have been used to develop a temporally sensitive model for localized land-use strategies at the former Khmer capital (Bâty 2005; Hawken 2013; Pottier 2000:111-112, 2012:19-20). A similar analysis will be attempted at Bagan, although our approach will also involve the excavation of certain agricultural features to determine construction techniques, usage patterns, and chronology. Finally, our study of agricultural practices at Bagan will also consider the impacts of the precipitation regimes associated with the Medieval Climate Anomaly (MCA, 900-1300 CE) and the subsequent Little Ice Age (LIA: 1300-1570 CE), as these would have conditioned the agricultural potential of Myanmar’s Dry Zone (e.g., Lieberman 2003:103-112, 2009:330, 792, 2011:939; Lieberman and Buckley 2012:1052; Mackenzie 1915:44).

Figure 7. Configuration of the IRAW@Bagan settlement survey transects (each transect is 200 m wide and divided into a series of 50 x 10 m recording units, referred to as “Transect Units”).

**The Water Management Sub-Project**

Our water management sub-project is striving to reconstruct the relic water management system associated with Bagan’s peri-urban settlement zone. Access to water was an endemic issue at Bagan (Cooler 1997; Luce 1969:7) – given its Dry Zone location – and the inscriptions and chronicles inform us that most kings attempted to augment the city’s water supply through the construction of brick wells, dams, canals, and brick or stone-lined holding tanks (Kan Hla
1977:22; Luce 1969:76, 84, 256; Pe Muang Tin and Luce 1923:65, 131; Stargardt 1968:360-361). Although some of these features are still active, or at least discernable on the landscape, many are likely obscured from view as a result of having been silted up (Hudson 2004:2, 266). Be that as it may, recent examinations of Bagan’s water management system, carried out by Elizabeth Moore and colleagues (Moore et al. 2016) and Win Kyaing (2016, 2018), have indicated that Bagan’s peri-urban zone contains remnants of a complex and extensive, yet comparatively “small-scale” water management system comprised of seasonal ponds, streams, canals, formal tanks, deliberately positioned and planned temple complexes, and the moat surrounding the epicenter (Moore et al. 2016:285, 294-300, 302; see also Cooler 1997:22-23).

Our own investigations have included preliminary visitations to many of the known water management features in the peri-urban zone in May 2017 (Figure 8), and the mapping and excavation of water management features in the Tuyin-Thetso uplands (Figure 9) – including Nat Yekan sacred water tank – in May 2018 (Iannone et al. 2019). This highland area seems to have served as the literal and spiritual source for the rest of Bagan’s peri-urban water management system (Iannone et al. 2019; Luce 1969:76 345; Moore et al. 2016:285, 295; Ni Tut 2013; Nyan Hlaing Lynn 2017; Win Kyaing 2016, 2018).

Our ongoing modelling of Bagan’s broader water management system is being carried out using a GIS-based hydrological approach (Arc Hydro [see Maidment 2002]; ArcGIS [ESRI 2016]), and includes analysis of the direction of flow, flow accumulation, and watershed delineation (see Macrae 2017:214-225; Macrae and Iannone 2016:374-388). These hydrological characteristics are providing information concerning the interconnectivity of naturally occurring features – such as slopes, streams, and seasonal ponds – and cultural features, including
reservoirs, canals, weirs, and moats. The previously discussed transect survey program will be instrumental in collecting data for this modelling exercise, with field walkers being charged with recording information pertaining to the location, size, character, and interconnectivity of different components of the water management system. Excavation of select water management features will augment our understanding the system’s development and functionality. In considering how these various components of the water management system may have worked together to sustain Bagan’s urban population, it will again be crucial to retrodict the positive impacts that the *Medieval Climate Anomaly* (MCA, 900-1300 CE) would have had likely had on the Dry Zone’s precipitation regime (e.g., Lieberman 2003:103-112, 2009:330, 792, 2011:939; Lieberman and Buckley 2012:1052; Mackenzie 1915:44).

Figure 9. The water management system of the Thetso-Taung Ridge.
Supplementary Data Sets

Our unabashedly orthodox settlement archaeology program is being augmented by insights concerning residential patterning, agricultural practices, and water management gleaned from relevant ethnographic and ethnohistoric studies (Aung-Thwin 1990; Oo et al. 2003; Freestone 1974; Leach 1977; Sparkes and Howell 2003; Spate 1945; see also Dumarçay 1987) and our own ethnoarchaeological field work conducted in 2017 and 2018 in ten traditional villages located in and around Bagan’s monument zone (Iannone et al. 2017, 2018). Additional data are being generated through the consideration of relevant inscriptions (Blagden 1923; Duroiselle 1920, 1921a, 1921b, 1923; Frasch 2014; Taw Sein Ko 1899; Taw Sein Ko and Duroiselle 1919; U Mya 1934), retrospective chronicles (Luce 1969; Pe Muang Tin and Luce 1923), and Bagan’s visual arts (Pyiet Phyo Kyaw 2017). These diverse data sets are not only proving useful in terms of guiding our field-based search for potential neighborhood clusters, agricultural field systems, and water management features, but also with respect to helping us “flesh out” our understanding of past lifeways at classical Bagan.

Conclusions

Our settlement archaeology study at Bagan is clearly in its initial stages, and we have yet to generate any substantive insights concerning the character of classical Bagan’s peri-urban cityscape. That said, when trudging around Bagan’s contemporary monument zone one is a constantly reminded of how expansive, varied, and dynamic this pre-industrial metropolis once was. Bagan was, and continues to be, a special place to conduct archaeology. As with any ancient urban center, it also provides some unique challenges for a settlement archaeology project such as ours. As noted by Bob Hudson (2004:220) many years ago, when it comes to the archaeological investigation of Bagan: “There are physical problems due to the density of the existing buildings, which simply does not permit excavation.” In addition, any settlement archaeology project must also consider the presence of open-air museums, myriad pilgrimage centers, multiple towns and villages, including some with densely populated residential areas and commercial zones (Hudson 2004:246). Be that as it may, our research design has taken all these issues into consideration, and we believe we have been able to frame an effective, long-term settlement archaeology program for Bagan’s peri-urban zone that will ultimately produce tangible, and useful results.

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